IN SITU MAPPING OF THE ORGANIC MATTER IN CARBONACEOUS CHONDRITES AND MINERAL RELATIONSHIPS.

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Introduction: Carbonaceous chondrite organic matter represents a fossil record of reactions that occurred in a range of physically, spatially and temporally distinct environments, from the interstellar medium to asteroid parent bodies. While bulk chemical analysis has provided a detailed view of the nature and diversity of this organic matter [1], almost nothing is known about its spatial distribution and mineralogical relationships (although see: [2-3]). Such information is nevertheless critical to deciphering its formation processes and evolutionary history.

Approach & Technique: We have developed a microprobe two-step laser desorption photoionization mass spectrometer (μ–L^2MS) [4] to map the distribution of organic species *in situ* at the micron scale. Here we report organic analyses of the Tagish Lake (C-ungrouped), Bells (CM2), Murchison (CM2) and Vigarano (CV3) carbonaceous chondrites. Our μ–L^2MS instrument has previously been restricted to measuring aromatic hydrocarbons (PAHs). We have now overcome this limitation by using a vacuum ultraviolet (VUV) laser ionization source capable of non-resonant single-photon soft ionization of essentially *all organic species*. We obtained organic maps up to ~1000 amu from freshly fractured meteorite surfaces. The samples were later *Pt*-coated and their mineral and elemental compositions determined by field-emission SEM and EDX mapping.

Results & Discussion: We observed a broad range of organic species within the meteorite matrix. Individual molecular species and species of different functionalities (*e.g.*, non-polar *R-H* vs. polar *R-OH*/*R-SH*) were heterogeneous on 10's to 100's of μm scales. We did not observe chemical associations with individual mineral grains, suggesting that some molecules were mobilized by aqueous fluids during parent body alteration (e.g., [5]). We also observed organic 'hot-spots' in Tagish Lake and Murchison that were subsequently determined to be organic nanoglobules [6]. The organic globules are chemically similar to average matrix but are enriched in high mass organic species. Vigarano organic 'hot-spots' were also identified as fine-grained carbonaceous coatings on olivine grains. We also observed evidence that organic matter is concentrated in fine-grained phyllosilicate rims. Further studies will reveal the relationships between the formation and evolution of asteroidal mineralogy and organic matter.

References: [1] Pizzzarello et al. 2006. *Meteorites and the Early Solar System II*, 625-651; [2] Pearson et al. 2002. *MAPS* **37**, 1829-1833; [3] Kebukawa et al. 2010. *MAPS* **45**, 394-405 [4] Clemett & Zare 1997. *IAUS 178*, 305-320; [5] Wing & Bada 1991. *GCA* **55**, 2937-2942; [6] Nakamura-Messenger et al. 2006. *Science* **314**:1439-1442.